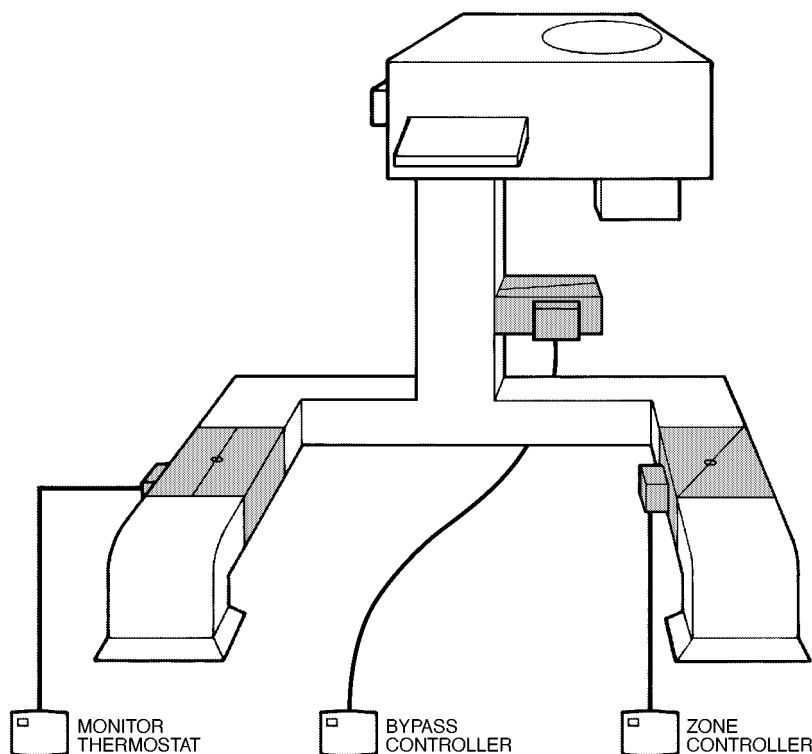




# Product Data

## 33CS Carrier Comfort System Variable Volume and Temperature (VVT®)



The VVT Comfort System provides the following features and benefits:

- 365-day scheduling, daylight savings compensation, and 8 daily program periods
- Quick and easy start-up wiring
- System control capability
- New adjustable alarm limit capability
- An Indoor Air Quality (IAQ) high limit CO<sub>2</sub> sensor is available
- Enhanced equipment coordination

### Features/Benefits

The newest generation of VVT System products combines the industry leading VVT System technology with the direct digital controls of the Carrier Comfort Network. The VVT Comfort System provides an effective balance between flexible zone comfort, diverse system application requirements, and efficient high-performance unit operation.

#### Scheduling flexibility for every application

An **electronic timeclock** provides 365-day scheduling of 8 occupied and unoccupied time periods. A 10-hour, non-battery clock backup during power outages protects your configurations and schedules. Multiple clocks can be used on the same network.

**Holiday scheduling** for up to 18 holiday schedules with multiple days per schedule allows flexibility and adaptability to the needs of each application. Daylight savings and leap year scheduling is also included.

**External timeclock control** can be used with the VVT® Comfort System thermostat to allow an external clock control of the occupied and unoccupied schedules.

**Network occupancy control** allows the VVT Comfort System thermostat to use its own occupancy schedule, or to follow the schedule of a network device. Schedules can be used by many different devices for ease of programming and serviceability.

## Control flexibility

**Occupant control of set points** allows the VVT Comfort System to satisfy all user comfort levels. Individually adjustable heating and cooling set points maximize occupant comfort for every scheduling requirement.

**Unoccupied override** allows the occupant to extend or return to the occupied set points by overriding the unoccupied schedule. The occupied schedule can be extended for 1 to 4 hours after the unoccupied scheduled start time.

**Temperature and time schedule access** is provided to suit the level of comfort of every occupant.

**Raised interface buttons** improve the look and feel of the interface which make configuration changes effortless.

**Rotating display** option provides two different information displays to suit the needs of the user. Set points or zone temperature and set points can be displayed.

## Wide scope of capabilities for all building requirements

**IAQ (indoor air quality) sensor** continuously monitors space or system air quality (CO<sub>2</sub>) and adjusts outdoor air intake as needed. An alarm is generated if the IAQ level exceeds the user-configured limits.

**Pre-occupancy purge** provides a “flushing” of the building one hour previous to the scheduled occupancy time.

**Remote room sensor averaging** improves the total comfort of the

conditioned space. When large zones exist with hot or cold spots, a total of 4 remote room sensor readings can be averaged.

**Demand limiting** integrates the energy management functions of the Loadshed module into the system to optimize participation.

**Tenant metering** offers an easy way to collect 3 different types of usage data. The amount of time that zone demand matches system mode, the amount of time that zone demand matches system mode during unoccupied override, and the amount of time that unoccupied override is active can be collected by tenant metering. The zone controller can collect the amount of time that supplemental heat is used.

**Supplemental heat** provides supplemental or zone heat independent of the central HVAC unit. Supplemental heat can be disabled when the outside air rises above a user-configured lockout set point.

## System performance is optimized

**System heating and cooling mode lockout** maximize the effectiveness of system heating and cooling requirements by disabling heating or cooling operation when the outside air temperature exceeds the configurable lockout set point.

**Optimal start** brings the conditioned space to within occupied set points

prior to the occupied time period to ensure occupant comfort.

**Optimized staging** maximizes first stage heating or cooling performance by suspending second stage operation when the first stage continues to meet space temperature requirements.

**Economizer operation** optimizes the use of outside air for cooling. When the outside air temperature is suitable for cooling, the economizer operates to condition the space, maintaining performance while reducing the system requirement for mechanical cooling.

## Reliable equipment operation maximizes unit dependability

**System mode demand** establishes the minimum number of zones that require heating/cooling before a system heating or cooling mode is selected. This unique sequence prevents the cycling of equipment attempting to meet troublesome requirements of a single zone.

**High- and low-temperature limit protection** ensures the supply-air temperature is maintained within a configurable unit-specific range. When acceptable temperatures cannot be maintained, heating and cooling stages will be shut off to ensure safe and proper operation of the equipment. This avoids having to reset the HVAC unit.

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# Features/Benefits (cont)



**Leaving-air temperature (LAT) algorithm** monitors the leaving- air temperature to ensure safe and proper operation of the HVAC equipment. The LAT is constantly monitored and system adjustments are made to maintain LAT requirements.

**Time Guard® compressor protection** prevents excessive equipment cycling by requiring a minimum down time after a heating or cooling cycle and a minimum heating and cooling run time.

**Staggered unit starting times** of multiple units upon power failure and at the start of occupied times reduces unnecessary electrical demand loads. The unique addressing of thermostats automatically provides this capability without additional configuration requirements.

## Serviceability and troubleshooting

**Advanced diagnostics** are built-in to the VVT® Comfort System and constantly verify proper system operation

and provide information to speed system troubleshooting.

**Fan and filter status** allows service needs to be pinpointed.

**Heating and cooling mode error set points** continuously monitor the supply-air temperatures. If the supply-air temperatures exceed the configurable error set points, then an operating error is generated to inform the service personnel of the condition.

**Error code display** on each thermostat provides a quick diagnosis of system operating status.

**Space comfort trending** eases troubleshooting. If space comfort temperature trends indicate a loss of comfort conditions, a comfort trend error is generated. The comfort trend error alerts the servicing contractor to provide quick resolution.

**Self-health test** is performed by the system to ensure proper system operation and performance.

## Simplified installation and configuration

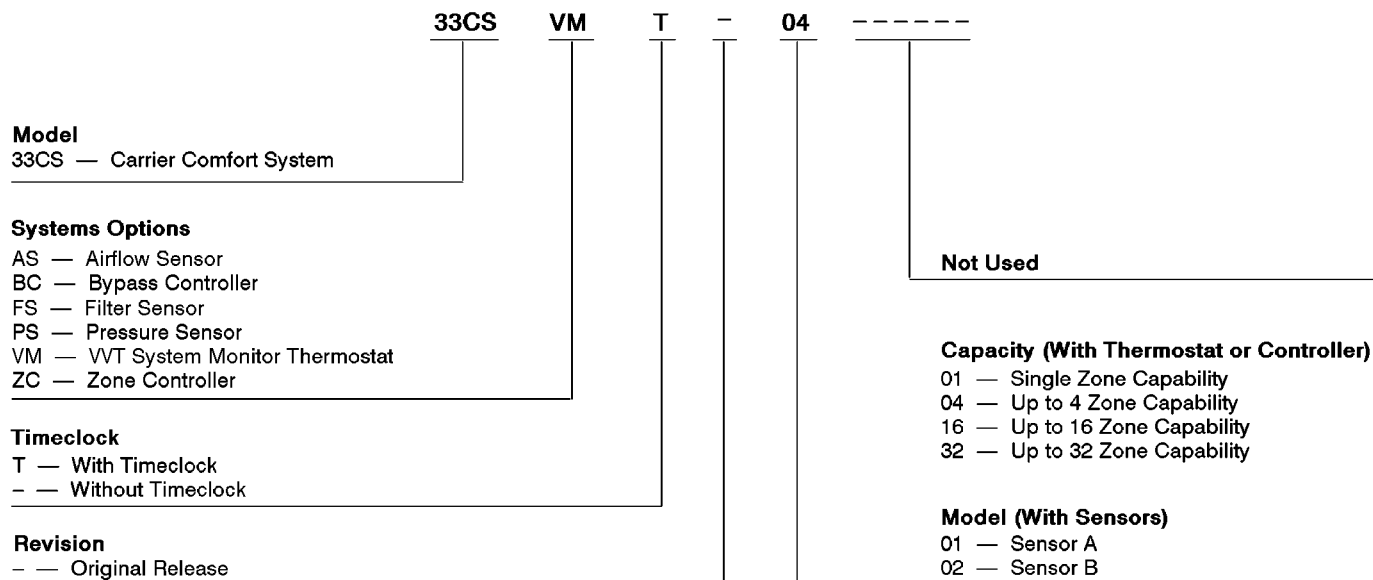
**Multiple configuration access levels** of security protect system configurations while providing occupant access to space temperature and operating schedules.

**Easily accessible function menus** make system setup and configuration intuitive, even for first time users. System displays present the data in a clear easy to read format, with all data grouped in logical categories.

**Start-up configuration category** contains essential start-up configuration options for a quick system setup. Typical default values are assigned to minimize start-up and configuration time.

**Full system configuration** is done at the thermostat. No additional computer or start-up configuration tools are required to complete system installation.

# Model number nomenclature



**Network access module** — Allows network access via computer at the site or remotely through the use of a modem. The Carrier Network Access software can modify and read information of devices residing on the network.

- **Fan status switch** — The fan status switch senses the condition of the unit indoor fan (ON/OFF).
- **Filter status switch** — The filter status switch senses the condition of the unit filter (CLEAN/DIRTY).

**Indoor air quality (IAQ) sensor (CO<sub>2</sub>)** — The indoor air quality sensor measures the amount of CO<sub>2</sub> present in the air in ppm. The amount of outside air being sent to the space is increased if the reading is above the configured set point. Three types of IAQ sensors are available: duct mount, wall mount, and wall mount with LED display.

**IAQ sensor calibration service kit** — The IAQ sensor calibration kit contains everything needed to calibrate the IAQ sensor. The kit contains: IAQ Sensor Software Calibration software, computer connection cable, calibration blanket, bottle of N<sub>2</sub> gas, bottle of CO<sub>2</sub> gas, pressure regulator, tubes, and clips.

**IAQ sensor software interface program** — The IAQ sensor is factory-set for an alarm at 1000 ppm of CO<sub>2</sub>. The setting can only be changed through the use of the IAQ sensor software interface program. The accessory also comes with a computer connection cable and an operation manual.

**VVT® system relay packs** — The CHR-03, CHR-06, CHR-06W, and HR-03 relay packs are used to connect the VVT Comfort System thermostat to the HVAC unit. Relay packs are available as a factory-installed option or a field-installed accessory.

For Monitor-Only mode operation, 33CSUCE-06 and TSR-01 relay packs are used. The 33CSUCE-06 relay pack is outdoor duty rated.

**Remote duct sensor (RDS)** — The RDS is mounted in the supply air duct and is used to sense duct temperatures between 30 and 180 F. The RDS is used for equipment protection.

**Remote room sensor** — The remote room sensor is used to report space temperature from a space at locations other than or in addition to where the thermostat is located. Up to 4 Remote Room Sensor readings can be reported to one thermostat and averaged.

**Outdoor-air sensor** — The outdoor-air sensor reads temperatures between 0 and 150 F and is used to report the outdoor-air temperature to the communication bus. The information can be used to lockout heating or cooling modes when the temperature is not within user configured limits. The outdoor-air sensor is needed when an economizer is used.

**Humidity sensor** — The humidity sensor is used to read the indoor relative humidity (between 10 and 90%) and broadcast the information to the communication bus.

**Static pressure pickup** — The static pressure pickup is used to modulate the bypass damper. It is used in pressure dependent applications.

**Velocity pickup** — The velocity pickup is used to measure the air velocity entering a zone for use in pressure independent applications. The information is used to modulate the zone damper. The velocity pickup is available in 12, 18, and 26-in. lengths to fit every application.

**Pressure sensor** — The pressure sensor is used to read the duct or zone pressures. The information is used to modulate the zone or bypass dampers. The pressure sensor is available for 0.5 and 2.0 in. wg applications.

**Round damper actuators** — Round damper actuators are available in 6, 8, 10, 12, 14, and 16-in. sizes. Connections are provided for sensors and monitor thermostat or zone controller wiring.

**Rectangular damper actuators** — Rectangular damper actuators are available in 8 x 10, 8 x 14, 8 x 18, and 8 x 24 in. sizes. Connections are provided for sensors and monitor thermostat or zone controller wiring.

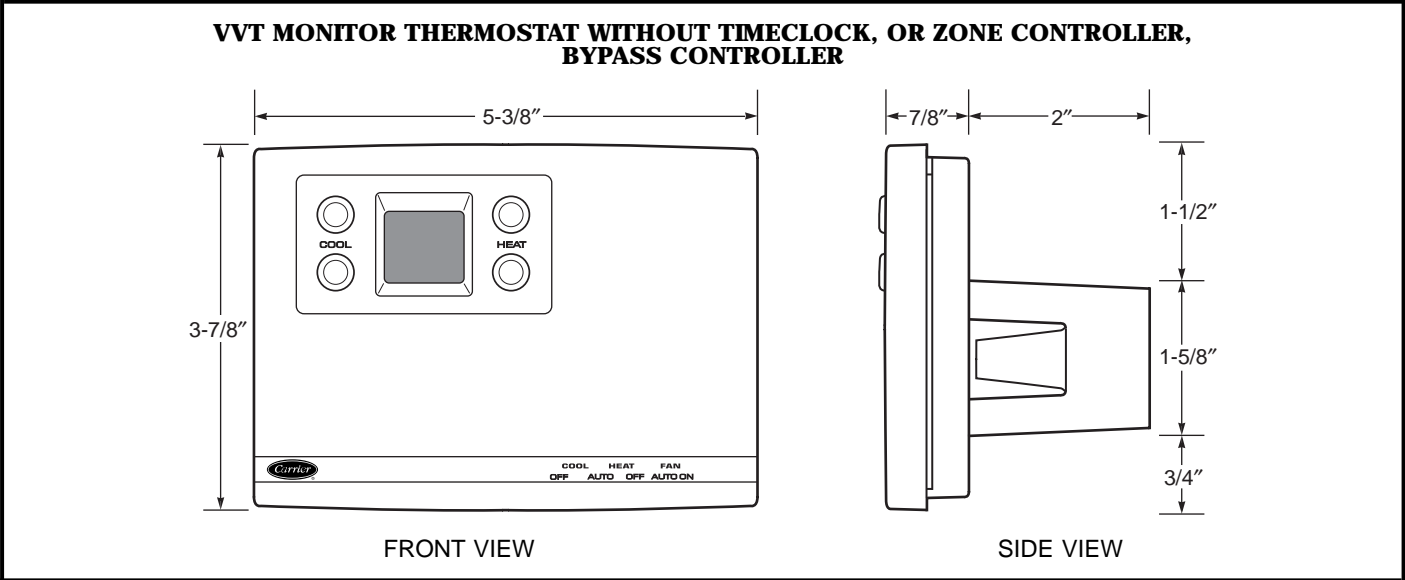
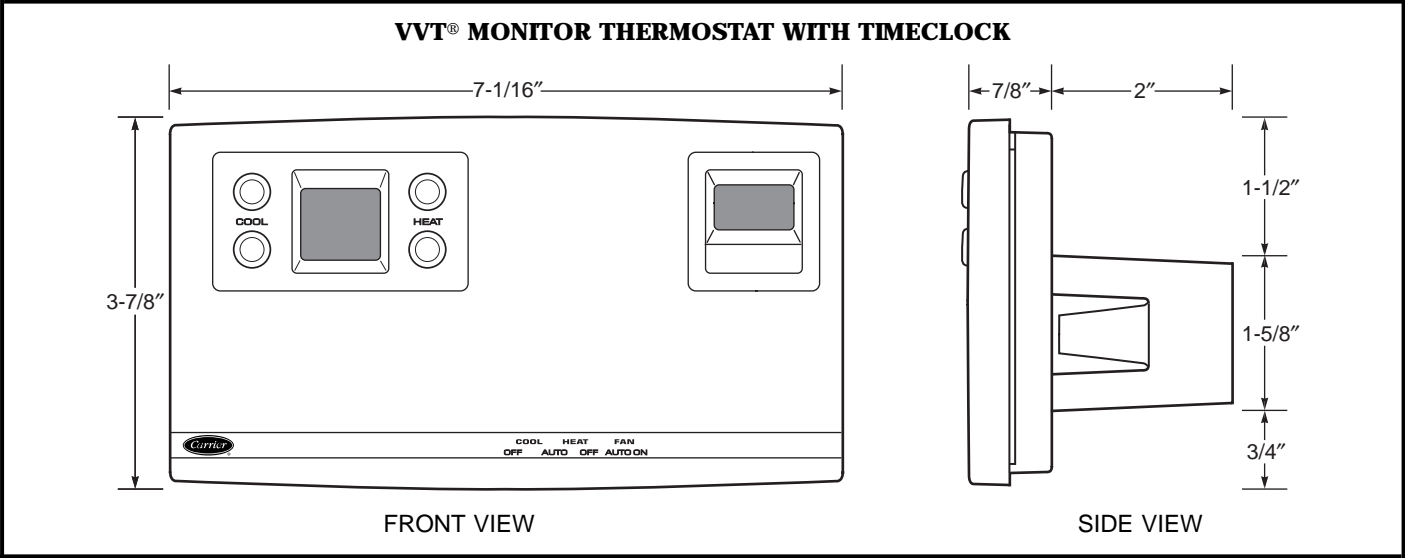
- **High torque actuators** — High torque actuators are available for applications with larger static pressures. High torque actuators provide higher torque and degrees of rotation.

**Pressure sensor wiring harness** — The pressure sensor wiring harness allows a pressure sensor and an IAQ sensor to be wired directly to a damper actuator. The pressure sensor harness is standard with the bypass actuator.

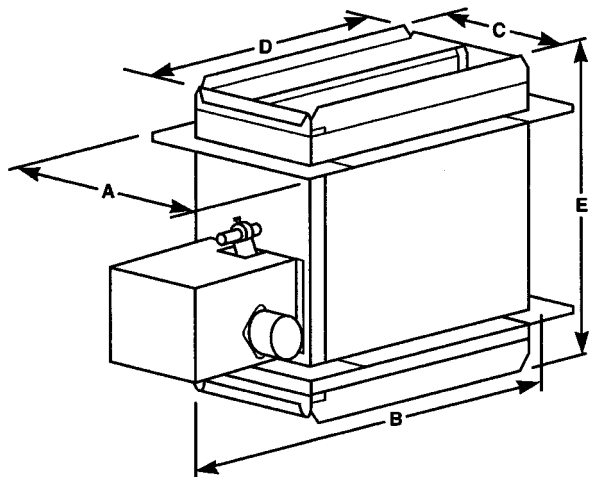
**Multi-sensor wiring harness** — The multi-sensor wiring harness allows the airflow sensor and filter sensor to be wired to the monitor thermostat damper actuator.

**Help screens for network access software** — A disk of help screens give the user on-line information about the monitor thermostat, zone controller, and bypass controller.

# Base unit dimensions



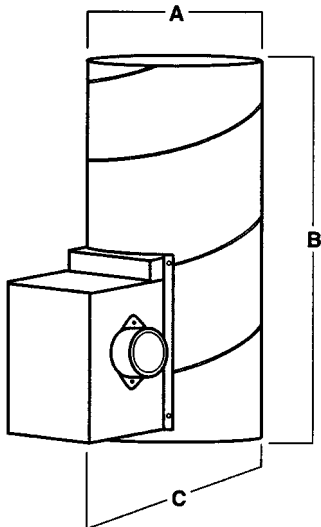
MODEL RD — RECTANGULAR ZONE DAMPER ACTUATOR



DIMENSIONS (in.)

MODEL	A	B	C	D	E
RD0810	10¼	17	8	10	13½
RD0814	10¼	21	8	14	13½
RD0818	10¼	25	8	18	13½
RD0824	10¼	31	8	24	13½

MODEL ZD — ROUND ZONE DAMPER ACTUATOR

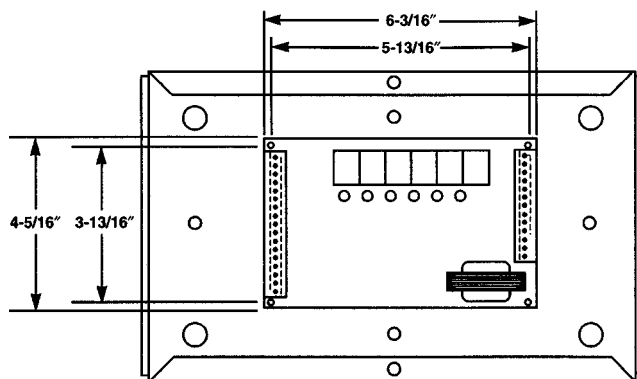


DIMENSIONS (in.)

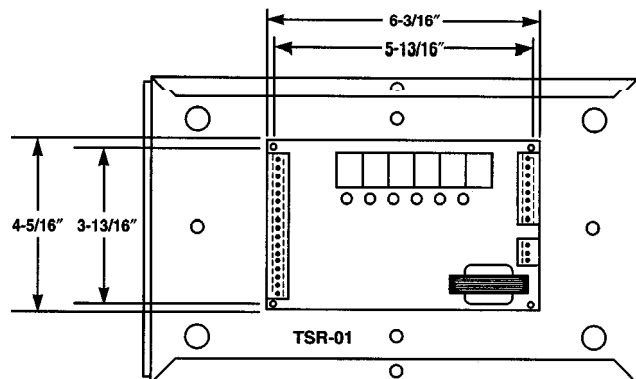
MODEL	A	B	C
ZD-06	6	18	11
ZD-08	8	18	13
ZD-10	10	18	15
ZD-12	12	24	17
ZD-14	14	24	19
ZD-16	16	24	21

→ **UNIT CONTROL RELAY PACKS**  
(Monitor-Only Mode Applications)

**MODEL 33CS UCE-06 MOUNTED IN  
RE (REMOTE ENCLOSURE)  
WITH ECONOMIZER CONTROL  
AND OUTDOOR DUTY RATED**

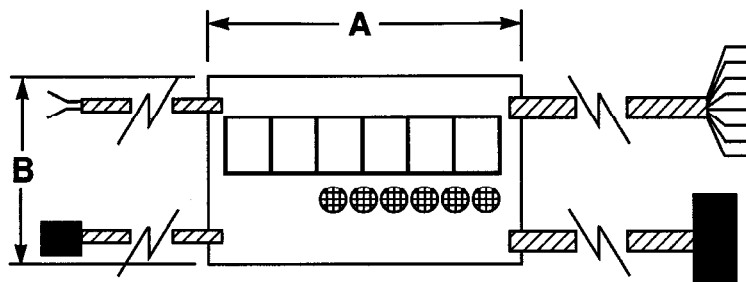


**MODEL TSR-01 MOUNTED IN  
RE (REMOTE ENCLOSURE)  
WITH REVERSING VALVE  
CONTROL AND INDOOR DUTY RATED**



**UNIT CONTROL RELAY PACKS**  
(VVT® Monitor Mode Applications)

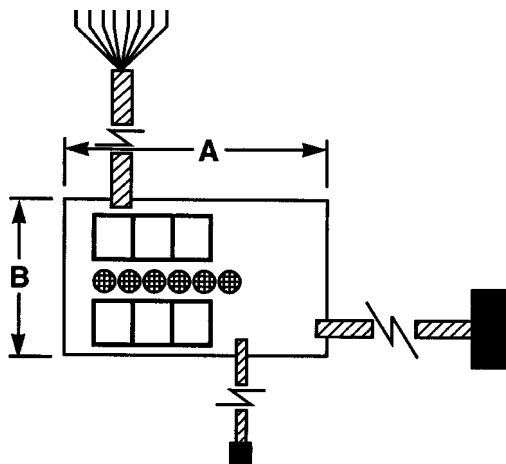
**MODEL CHR-06W WITH ECONOMIZER CONTROL AND INDOOR DUTY RATED**



**DIMENSIONS (in.)**

MODEL	A	B
CHR-06W	4¾	3

**MODEL CHR-06 WITH REVERSING VALVE CONTROL AND INDOOR DUTY RATED**



**DIMENSIONS (in.)**

MODEL	A	B
CHR-06	4¾	3

Proper selection of the monitor thermostat is important to meet job requirements. Selection of the monitor thermostat and other components is based on the following criteria:

## **I Zone Capacity**

Monitor thermostats are available in 3 capacities: 4, 16, or 32 zones. A system with 4 zones would require an 33CSVM(T)-04 monitor thermostat which would control one zone and 3 zone controllers (33CSZC--01) for the remaining zones. A 20-zone system would require a 33CSVM(T)-32 monitor thermostat and 19 zone controllers.

## **II Timeclock**

Monitor thermostats are available in timeclock and non-timeclock versions. Select the monitor thermostat with timeclock when that monitor thermostat will be the device broadcasting time to the other devices on the network. A "T" in the 7th digit of the model number indicates a timeclock (i.e., 33CSVMT-04). A dash indicates no timeclock (i.e., 33CSVM--04).

## **III Mode**

Monitor thermostats can be used in 2 modes: VVT® Monitor mode and Monitor-Only mode. In VVT Monitor mode, the monitor thermostat controls its own damper. An 8-zone system would have one monitor thermostat (in VVT Monitor mode) and 7-zone controllers. In Monitor-Only mode, the monitor thermostat does not control a zone damper. An 8-zone monitor-only system would have one monitor thermostat (in Monitor-Only mode) and 8-zone controllers.

## → **IV Relay Pack**

Relay pack selection is based on operating environment and application. A Monitor-Only mode application can use either a TSR-01 or 33CSUCE-06 relay pack. Select the TSR-01 relay pack for indoor mounting environments. Select the 33CSUCE-06 for outdoor duty environments. It is also used in units having a W-973 controller. Both relay pack models offer 2-stage heat and cool and ON/OFF fan control.

For VVT Monitor mode applications, select the CHR-06 or CHR-06W relay pack. Both are for indoor mounting environments. They are also used in units having a W-973 controller. Both relay pack models offer 2-stage heat and cool and ON/OFF fan control.



## APPLICATION NC\* LEVELS (RADIATED SOUND) — ROUND ZONE DAMPERS

DAMPER	CFM	STATIC PRESSURE (in. wg)	NC LEVEL
ZD-06	160	0.02	<20
		0.52	<20
		1.00	25
	200	0.04	<20
		0.50	22
		1.00	24
	240	0.06	<20
		0.50	24
		1.00	28
	360	0.10	28
		0.50	32
		1.00	35
ZD-08	280	0.03	<20
		0.50	<20
		1.00	22
	350	0.04	<20
		0.50	22
		1.00	22
	420	0.06	28
		0.50	25
		1.00	27
	630	0.10	28
		0.50	28
		1.00	30
ZD-10	440	0.01	22
		0.50	25
		1.00	27
	514	0.02	22
		0.50	28
		1.00	29
	584	0.03	25
		0.50	27
		1.00	32
	659	0.04	30
		0.50	32
		1.00	34
	990	0.09	35
		0.50	35
		1.00	37
ZD-12	630	0.01	22
		0.50	35
		1.00	38
	700	0.03	22
		0.50	37
		1.00	38
	770	0.02	22
		0.50	38
		1.00	39
	860	0.04	27
		0.50	39
		1.00	40
	950	0.05	32
		0.50	40
		1.00	40
	1425	0.11	40
		0.50	44
		1.00	45

\*Noise Criteria.

NOTE: The NC values are based on ARI (Air Conditioning and Refrigeration Institute) Standard 885-90 application assumptions.

# Performance data (cont)



## APPLICATION NC\* LEVELS (RADIATED SOUND) — ROUND ZONE DAMPERS (cont)

DAMPER	CFM	STATIC PRESSURE (in. wg)	NC LEVEL
ZD-14	852	0.02	22
		0.50	30
		1.00	35
	976	0.01	25
		0.50	32
		1.00	36
ZD-14	1074	0.01	30
		0.50	32
		1.00	27
	1175	0.01	31
		0.50	35
		1.00	38
ZD-14	1275	0.06	30
		0.50	36
		1.00	39
	1910	0.13	41
		0.50	45
		1.00	47
ZD-16	1125	0.02	27
		0.50	39
		1.00	41
	1175	0.04	30
		0.50	39
		1.00	41
	1275	0.05	31
		0.50	40
		1.00	42
ZD-16	1376	0.05	35
		0.50	41
		1.00	44
	1475	0.06	35
		0.50	42
		1.00	45
	1574	0.07	36
		0.50	44
		1.00	46
ZD-16	1676	0.03	38
		0.50	45
		1.00	46
ZD-16	2512	0.18	50
		0.50	51
		1.00	54

\*Noise Criteria.

NOTE: The NC values are based on ARI (Air Conditioning and Refrigeration Institute) Standard 885-90 application assumptions.

# **APPLICATION NC\* LEVELS (RADIATED SOUND) — RECTANGULAR ZONE DAMPERS**

DAMPER	CFM	STATIC PRESSURE (in. wg)	NC LEVEL
RD0810	410	0.01 0.50 1.00	<20 30 45
	509	0.03 0.50 1.00	<20 30 40
	610	0.07 0.50 1.00	23 31 40
	914	0.16 0.50 1.00	35 37 45
RD0814	561	0.02 0.50 1.00	<20 36 47
	625	0.02 0.50 1.00	22 37 45
	725	0.03 0.50 1.00	25 38 45
	825	0.05 0.50 1.00	32 40 46
	1237	0.11 0.50 1.00	40 45 54
RD0818	725	0.01 0.50 1.00	22 38 48
	775	0.01 0.50 1.00	22 38 48
	874	0.02 0.50 1.00	28 40 48
	974	0.02 0.50 1.00	30 42 48
	1075	0.03 0.50 1.00	33 44 50
	1611	0.06 0.50 1.00	40 50 60
RD0824	925	0.01 0.50 1.00	26 38 48
	974	0.01 0.50 1.00	27 38 50
	1075	0.01 0.50 1.00	32 40 50
	1175	0.02 0.50 1.00	35 41 50
	1275	0.02 0.50 1.00	37 43 50
	1375	0.03 0.50 1.00	38 44 50
	2062	0.06 0.50 1.00	47 50 55

\*Noise Criteria.

NOTE: The NC values are based on ARI (Air Conditioning and Refrigeration Institute) Standard 885-90 application assumptions.

## Supplemental heat

Supplemental heat is used to provide control of zone duct or perimeter baseboard heat. It can either augment the heat of the central unit or be the primary source of heat. Supplemental heat can only be controlled by a zone controller.

The staging of the heating mode is dependent on the type of supplemental heat.

→ **Parallel fan box** — With 1.0° F demand, the fan is energized. With 2.0° F demand, the first stage of heat is energized. With 2.5° F demand, the second stage of heat is energized.

**Series fan box** — The fan runs continuously during occupied mode. With 1.5° F demand, the first stage of heat is energized. With 2.0° F demand, the second stage of heat is energized.

**Baseboard** — The fan is not used. With 1.5° F demand, the first stage of heat is energized. With 2.0° F demand, the second stage of heat is energized.

**Duct mounted heat** — With 1.5° F demand, the first stage of heat is energized. With 2.0° F demand, the second stage of heat is energized. Fan use requires a system fan. The zone controller requests the monitor thermostat to turn on the system fan. If the VVT® system is hydronic, the first stage is energized 30 seconds prior to the request for system fan.

During supplemental heat, the zone controller will work to maintain the zone set points. During supplemental heat mode requiring the system fan (duct mounted heat), the zone controller maintains the damper at the configured Supplemental Heat Damper Position. If using a series fan box, parallel fan box, or baseboard heat, the damper is maintained at the minimum damper position.

## Communications

The Carrier Comfort system is a communicating system of zone controlling thermostats. Through communications, information is shared between zones, which optimizes the use of the HVAC equipment. Communications also permit the installer and owner to view and monitor the overall operation of the system.

Communications take place over a 3-wire shielded cable which is wired to the thermostat connector block. The wiring must be made in daisy chain fashion from one thermostat to another.

Once the communication cable has been installed and the thermostats have been connected to the cable through the connector blocks, it is necessary to give the thermostat a unique identity on the communication bus. This is accomplished through the device address. The device address has two parts: the element address (specific to the device) and the bus address (the branch of the communication bus the device is on). If only one continuous link of devices exists, the bus address would be 0.

It is possible to break the system into several branches or subsystems. These branches would be called secondary buses. A bridge is needed to create a secondary bus. To correctly address the devices under the bridge, all thermostats must have a bus address which is identical to the element address of the bridge. For example, if the bridge (which is on the

main bus) has a bus/element address of 0,75, the thermostats on the bridge would have a bus address of 75. Branches may be added to separate various systems or to reduce the communication traffic on the main bus.

The VVT system monitor thermostats are available in 3 different zone capacity models which allow it to communicate with 4, 16, or 32 system components. When addressing the zone controllers, it is not necessary to have sequentially addressed zone controllers physically next to each other. Within a VVT system, the monitor thermostat must have the highest address. The bypass controller and zone controllers are addressed sequentially below that.

## Selection of damper sizes

All zone dampers (round and rectangular), are equipped with: supply air temperature sensors, a plug-in wiring header for the relay pack, a plug-in wiring header for available sensors (humidity, temperature, pressure, or CO<sub>2</sub>).

Based on required airflow to the zone, round dampers are available in 6 sizes to provide optimum airflow for low pressure applications (1.0 in. wg). Round dampers should be selected based on the cfm (nominal and maximum) shown in the table below.

**ROUND DAMPER SIZES**

MODEL	SIZE (diam. in.)	ZONE CFM	
		Nominal (800 fpm)	Maximum (1200 fpm)
ZD-06	6	160	240
ZD-08	8	280	420
ZD-10	10	440	660
ZD-12	12	630	950
ZD-14	14	850	1275
ZD-16	16	1125	1675

Rectangular dampers should be selected based on the cfm (nominal and maximum) shown in the table below.

**RECTANGULAR DAMPER SIZES**

MODEL	SIZE (H x W in.)	ZONE CFM	
		Nominal (800 fpm)	Maximum (1200 fpm)
RD0810	8 x 10	410	610
RD0814	8 x 14	560	825
RD0818	8 x 18	725	1075
RD0824	8 x 24	925	1375

For applications requiring 2 or more dampers working together to provide the required total airflow, the dampers have the capability of being wired together. If space restrictions do not allow the use of a 14-in. damper, two 10-in. round dampers could be wired together to provide the required airflow. In these situations, only one monitor thermostat or zone controller is needed to provide control. It is wired (5-wire cable) to one of the 2 dampers which is designated the master damper. Wiring from the master damper to the additional (slave) dampers is accomplished using 3-wire cable. The master damper is sequenced from the monitor thermostat or zone controller while the slave damper(s) modulate based upon the movement of the master damper.

## Damper positions

The dampers provide for full-blade modulation from fully-closed to fully-open. This is designated as position 0 to position 15. Because individual zone requirements differ from one building to another, the system has been equipped to provide minimum and maximum damper positions. Maximum damper position changes the fully-open damper position to a maximum damper position which can be less than or equal to the maximum (which is 15). Minimum damper position changes the fully-closed damper position to a minimum damper position which can be more than or equal to the minimum (which is 0).

The range of the maximum damper position is from 8 to 15, in increments of 1. The flexibility of the maximum damper position allows airflow requirements through the damper to be fine-tuned to best satisfy the space. When space use changes, airflow can be readjusted to suit the requirements of the new space configuration.

- The range of the minimum damper position is from 0 to 7, in increments of 1. The adjustment capability allows fine-tuning of airflow into the space. Minimum circulation levels can be provided to ensure space comfort.

A ventilation damper position and a supplemental heat damper position are also used. Refer to the Indoor Air Quality and Supplemental Heat application sections for more information. Refer to the Radiated Sound performance tables for damper sound information.

## Indoor air quality

The IAQ (indoor air quality) feature allows the Carrier Comfort system to interface with the economizer on the HVAC equipment and maintain the quality of indoor air within acceptable limits. An IAQ sensor ( $\text{CO}_2$ ) is used to monitor the IAQ levels in the zone or the return air duct. The monitor thermostat controls the system fan and economizer during an IAQ mode.

The IAQ feature can be defined as system or local IAQ. Local zone IAQ consists of a zone controller with an IAQ sensor. When the IAQ alarm is tripped in local mode, only the zone damper of the zone controller enters IAQ mode.

- For local IAQ, the monitor thermostat scans the bus to gather information and monitors the status of the zone controllers. When a zone controller gives the monitor thermostat a local IAQ alarm (zone controller with local IAQ sensor), the monitor thermostat turns on the system fan (if in occupied mode). If the IAQ economizer delay is satisfied and a zone still has a local IAQ alarm, the monitor thermostat checks the outdoor air against the humidity and temperature lockouts. If the IAQ lockout functions are not tripped, the economizer relay is energized to bring fresh air into the zone. When the zone IAQ is satisfied or the reset temperature is reached, the monitor thermostat will deenergize the economizer relay. The system fan will return to its normal operating mode.

System IAQ consists of a VVT® system with a bypass controller having an IAQ sensor or a monitor thermostat in monitor-only mode having an IAQ sensor. A monitor thermostat in VVT monitor applications has no free inputs for an IAQ sensor. When an IAQ alarm is tripped on the bypass controller or monitor thermostat, all system elements which are user-configured to join system IAQ will enter IAQ mode.

- For system IAQ, the monitor thermostat scans the bus to gather information and monitors the status of the bypass controller and zone controllers. When the bypass controller or the monitor thermostat (in monitor only mode) has a system IAQ alarm, the monitor thermostat starts IAQ system mode and energizes the system fan (if in occupied mode). The monitor thermostat sends all the zone controllers the system IAQ alarm. The bypass control moves to control the IAQ Pressure Set Point. The zone controllers look at their system IAQ options to determine if they will participate in system IAQ mode. Each device checks the reset temperature to determine if IAQ is acceptable for its zone. All zone controllers in system IAQ mode will position their dampers in the maximum damper position. If the IAQ economizer delay is satisfied and a zone still has a local IAQ alarm, the monitor thermostat checks the outdoor air against the humidity and temperature lockouts. If the IAQ lockout functions are not tripped, the economizer relay is energized to bring fresh air into the zone. The bypass controller will modulate its damper to keep a user-configured amount of air flowing into the zone. When the system IAQ is satisfied or the reset temperature is reached, the monitor thermostat will deenergize the economizer relay. The system fan will return to its normal operating mode.

The following sections describe the IAQ functions and options of the monitor thermostat, zone controller, and bypass controller.

**Monitor thermostat** — The monitor thermostat controls the system fan and economizer during an IAQ mode. The monitor thermostat has 8 configurable IAQ options that allow the IAQ mode to be customized for each application.

The monitor thermostat can be configured to participate in system IAQ mode or to operate its zone normally.

The monitor thermostat can be configured to operate with or without an IAQ sensor connected to its relay pack (monitor-only mode).

The monitor thermostat can configure how long the indoor fan will operate before the economizer relay is energized. With a Carrier integrated economizer, the outside air damper will go to the minimum position when the indoor fan is energized after an alarm. If the monitor thermostat is still receiving an IAQ alarm after the economizer delay has expired, the monitor thermostat will energize the economizer relay and drive the economizer to the fully-open position.

- The monitor thermostat has a temperature reset function which will allow fresh air to be brought into a zone even if the temperature set points are exceeded. When warm, fresh outside air is brought into a cooled zone, or cool, fresh outside air is brought into a heated zone, the zone temperature may drop or rise above user-configured limits. The temperature reset function allows the zone temperature to rise over the cooling set point or drop under the heating set point within a user-configured limit to allow the indoor air quality time to improve.

The monitor thermostat has 3 lockout functions which will keep the system from entering IAQ (energizing the economizer relay). The system can lockout on high outdoor humidity, low outdoor air temperature, and high outdoor air temperature.

If the outdoor humidity is above the user-configured set point, the system will not energize the economizer relay. The outdoor humidity must be read and broadcast by another device on the communication bus (such as a Comfort Controller). If the monitor thermostat is not receiving outside humidity, the humidity lockout will not function.

- If the outdoor-air temperature is above or below the user-configured set point, the system will not energize the economizer relay. The outdoor air temperature can be read by an outdoor air sensor wired to the monitor thermostat or broadcast by another device on the communication bus. If the monitor thermostat is not receiving outdoor air temperature, system will not energize the economizer relay.

The monitor thermostat has an IAQ alarm delay function which configures how long the monitor thermostat will wait before sending an IAQ alarm to the communication bus.

- **Zone controller** — During the time that the zone controller is participating in the IAQ sequence, the zone controller positions its damper at the maximum damper position for pressure dependent applications and at the cfm/airflow set point for pressure independent applications. If the zone controller is equipped with an optional CHR-06W or CHR-06 relay, the AUX contacts on the relay are energized when the monitor thermostat energizes the economizer on the first zone to indicate local IAQ mode. Only the zone controller economizer which signalled first is energized. When that zone IAQ is satisfied, the next zone with local IAQ will energize AUX.

The zone controller has a temperature reset function which will allow fresh air to be brought into a zone even if the temperature set points are exceeded. When fresh heated air is brought into a heated zone, or conditioned cooled air is brought into a cooled zone, the zone temperature may rise or drop beyond user-configured limits. The temperature reset function allows the zone temperature to rise or drop a user-configured limit beyond the set point to allow the indoor air quality time to improve.

The zone controller has a system IAQ configuration option which configures the zone controller to participate in system IAQ mode or to ignore a system IAQ mode.

The zone controller has an IAQ sensor configuration option which is used if an IAQ sensor is attached to the zone controller for local IAQ.

The zone controller has alarm delay function which configures how long the zone controller will wait before sending an IAQ alarm to the communication bus.

**Bypass controller** — When an IAQ sensor is connected to the bypass controller, it is the system IAQ sensor. The bypass controller maintains the IAQ pressure set point during IAQ mode. After the bypass controller has satisfied the IAQ alarm, the IAQ system alarm will continue for 4½ minutes to further reduce the CO<sub>2</sub> levels. If the bypass controller has an AUX relay, it can be used to energize a system exhaust fan. The AUX contacts on the relay are energized when the monitor thermostat energizes the economizer.

The bypass controller has an IAQ sensor configuration option which is used if an IAQ sensor is attached to the bypass controller for system IAQ.

The bypass controller IAQ pressure set point is maintained by the bypass controller during system IAQ operation. This is usually set higher than normal operating pressure in order to force more air into the zones that are participating in system IAQ. This helps to quickly eliminate the IAQ alarm.

The bypass controller has alarm delay function which configures how long the bypass controller will wait before sending an IAQ alarm to the communication bus.

## → Pressure independent systems

Pressure independent (PI) operation refers to maintaining a specific airflow into a space, independent of the upstream static pressure. Pressure independent operation should be used: when a specific number of air changes every hour is needed, when using a high pressure system such as a VAV air handler, or when the cfm entering a space needs to be monitored.

The equipment needed for a PI zone is: a zone damper, a pressure sensor, a set of PSP or velocity pressure pickup tubes, and a zone controller.

The pressure sensor must be located in a conditioned space where the ambient temperature is between 50 and 115 F for accurate low pressure readings.

The PSP or velocity pressure pickup tubes need to be located in an area of laminar flow. Laminar flow requires a minimum of 1½ duct diameters down stream and 5½ duct diameters upstream of the straight duct.

The minimum airflow at the PSP pickup tube location must be equal or greater to 896 fpm (.05 in. wg of velocity pressure). The PSP pickup tubes cannot accurately read airflow below this value. To make up for low flow requirements, a section of the ductwork upstream of the damper may need to be downsized.

## Retrofit and planned renovation applications

Retrofit and planned renovation are the two major areas where new controls systems are applied to existing buildings. Upgrading controls or dampers for a job is a typical retrofit application. Major modification of a non-zoned system to a zoned system is beyond the scope of a typical retrofit application.

For a planned renovation, the scope of the application is greater than a retrofit application. In a planned renovation, the unit and controls are usually upgraded. The duct layout may be extended and zoning damper actuators may be added for additional comfort control.

Typically, any existing ductwork and dampers will remain in place. To upgrade a series of pneumatic damper controls to electronic Carrier Comfort System controls, the existing ductwork and dampers do not need to be removed. The pneumatic actuators are removed from the damper or box, and the new electronic actuator is installed in its place.

→ To retrofit an application with Carrier Comfort System controls, the unit controller is replaced with a CHR-06 or CHR-06W relay pack. The control relay pack is wired to the terminal strip of the unit and provides cooling, heating, fan, reversing valve, or economizer relay control for the unit. A monitor thermostat must be wired to each relay pack.

For retrofit and planned renovation applications using existing zoning control damper actuators, or adding new zoning control actuators and dampers, the proper actuator must be selected. For each damper actuator upgraded or added to the system, a corresponding zone controller must be installed to control the actuator.

Replacement actuators are available in 3 configurations: ZD/RD, MA, and HTA. The ZD/RD actuators come factory installed on round (6, 8, 10, 12, 14, 16-in.) or rectangular (8-in. by 10, 14, 18, or 24-in.) dampers. Complete ZD/RD dampers with actuators are typically used in planned renovations where ducting and new zoning capabilities are being added. The MA and HTA actuators are used on existing dampers to upgrade the actuator.

Each actuator is designed to accept a 1/2-in. diameter damper shaft. The zone controller can be configured to operate the damper in either clockwise or counterclockwise directions, with the specific degree of travel.

#### DAMPER ACTUATOR CHARACTERISTICS

ACTUATOR	TORQUE RATING (in. lb)	DEGREE OF ROTATION
ZD/RD	18	45
MA-08	18	60
HTA-02	80	60
HTA-03	45	90

→ Typical wiring requirements are: 7-conductor wire from unit to unit controller relay pack; 3-conductor wire with shield between thermostats and 5-conductor shielded wire from the monitor thermostat or zone controller to the damper.

Refer to the Accessories section for information on the sensors available to maximize the operation of the comfort system.

In addition to sensors, the following can be added to upgrade an application: full capability for communication to provide both local and remote access; pressure independent operation for specific zone airflow requirements; and zone supplemental heat during periods of central unit cooling. These topics are covered in detail in other parts of the Application data section.

### Selecting a bypass system for VVT® Comfort Systems

The purpose of the bypass is to account for fluctuations in the supply air pressure caused by the zone dampers modulating to satisfy individual set points. The bypass system allows a constant volume HVAC unit to supply variable volumes of air to the system. The system bypasses air from the supply side of the unit to the return side of the unit using either a plenum or ducted return.

The components needed to build a bypass for a VVT system are: a static pressure pickup, a static pressure sensor, a bypass damper (with actuator), and a bypass controller.

The static pressure pickup delivers the system static pressure to the static pressure sensor. The damper modulates open or closed based on maintaining a pre-configured static pressure set point. The configuration of the bypass system parameters is done at the bypass controller. During system mode changeover, the bypass damper will remain open until the configured supply-air temperature is reached, thereby averting the sending of undesirable conditioned air to calling zones.

The typical environment of the bypass system is 1 in. or less of external static pressure. For typical rooftop systems, the standard VVT damper (ZD/RD) should be used. For conditions which require a larger static pressure, a 35D VAV box and a high torque actuator (HTA) should be selected.

Determining the proper size for the bypass damper is critical for the operation of the VVT system. If the damper selected is too large, it may have to modulate more than necessary to react to system pressure changes. The ability of the system to stay within a pressure range is compromised.

When the damper is undersized, the capability of the damper to control the pressure may be compromised due to the inability to bypass enough air volume. An undersized damper also creates higher airflow velocities which add to the noise generated by the system.

Care should be taken in the layout of the system to prevent undesirable “feedback” into the zones. Return grilles in ceilings should be located to minimize the possible backflow from a plenum type bypass system. The ceiling return should not be located too close to the plenum bypass ducts to prevent hot or cold bypass air from entering the occupant space through the plenum return.

On jobs using a ducted return air system, the use of an economizer could inadvertently cause the unit bypass air to be sent to the zones, since the return dampers of the HVAC unit may be closed. If the return dampers are closed, the airflow can go backwards through the return duct and into the conditioned spaces through the return grilles. The return duct should be sized properly to handle bypassed air from the unit. A backdraft damper may need to be located between the connection of the bypass duct and the closest room return if bypassed air is entering the conditioned space.

Care must be taken when sizing the system to prevent undesirable impact on unit temperature limits. In situations where most of the unit discharge air is being bypassed into the return system (when most of the zone dampers would be closed), the temperature of the system return air is going to be close to the temperature discharge air. When the return air is drawn back through the unit to be heated or cooled, the resulting discharge air temperature can be close to or exceed the safe temperature limits of the unit. The safety limit switch will shut down the unit while zone space temperatures remain unsatisfied. Size the system so cycling of the return air does not result in unsafe temperatures.

## Alarm configuration and application

This section describes the major alarm types that are available within the system. The alarm types are: space temperature alarm (Comfort Trend), discharge air temperature alarm, fan status alarm, filter status alert, IAQ status alarm, communication failure alarm, and stuck gas valve alarm.

The section describes each alarm in detail: what controllers it works with; the sensors required for the alarm to be activated; and how the alarm is configured, disabled, and normalized. The description provides information on how the alarm is applied and the necessary hardware required for proper operation.

**Space temperature alarm (Comfort Trend)** — See the Space Temperature Alarm table below for alarm specifications.

**SPACE TEMPERATURE ALARM**

FUNCTION	DESCRIPTION
Controllers	Monitor Thermostat/Zone Controller
Sensor Required	None (Space Temperature Sensor is in Thermostat)
Sensor Wiring	None, Sensor Integral to Thermostat
Input	Comfort Trend Demand Comfort Trend Time Limit
Output	SE-01 Comfort Trend Error (Space Temperature Alarm)
Configuration Option	Comfort Trend Demand Comfort Trend Time Limit
Configuration Values	Range 0° F to 25.5 F Range 0 to 255 minutes
Configuration Increments	0.1° F 1 minute
Associated Functions	None

### Operation

A space temperature (Comfort Trend) alarm indicates when the system is unable to maintain space temperature comfort conditions. Space temperature alarms are an indication that the HVAC system operation has difficulty maintaining zone space temperature. The temperature demand of the space or zone is the difference between the set point (either heating or cooling) and actual space temperature of the zone.

When the demand of the zone exceeds the Comfort Trend Demand value, the thermostat begins to calculate the temperature trend of the zone. The temperature trend is simply the “real time” ability of the space to lower or reduce the temperature demand of the space. The time is measured during the period when the temperature trend does not show improvement, or indicates conditions between set point and space temperature are getting worse. When the length of time measured reaches the Comfort Trend Time Limit value, a space temperature alarm is initiated.

### Configuration example

Occupied Space Cooling Set Point ..... 72 F  
Occupied Space Heating Set Point ..... 68 F  
Comfort Trend Demand ..... 4.5 F  
Comfort Trend Time Limit ..... 7 minutes

The system is operating normally without alarm during the cooling mode. The trend of the space temperature indicates that the system is unable to keep the space within set points, and space temperature rises to 76.5 F. The trend of the space temperature does not improve, and temperature conditions are getting worse for at least 7 minutes. At that time, a space temperature (Comfort Trend) alarm (SE-01) is initiated. The alarm will automatically clear when the system can properly maintain space temperature conditions within the space.

→ The alarm is removed using the manual reset or by setting demand to 0. The system will not return to normal without being reset.

**Discharge-air temperature alarm (Heat/Cool mode error)** — See Discharge Air Temperature Alarm table for specifications.

**DISCHARGE-AIR TEMPERATURE ALARM**

FUNCTION	DESCRIPTION
Controllers	Monitor Thermostat
Sensor Required	Remote Duct Sensor (RDS): Monitor Only Mode Duct Temperature Sensor: VVT Monitor Mode
Sensor Wiring	RDS: Wires to Terminal 13 and 15 Duct Temp Sensor: None, Sensor Integral to Damper
Input	Unit Discharge Air Temperature
Output	SE-07 Heat Mode Alarm, SE-08 Cool Mode Alarm
Configuration Option	Heat Mode Alarm Set Point Cool Mode Alarm Set Point
Configuration Values	Heating: Min 0° F, Max 140 F Cooling: Min 0° F, Max 140 F
Configuration Increments	1° F
Associated Functions	None

### Operation

**Heating mode** — Alarm is issued when unit discharge temperature is not above the heating mode error set point.

**Cooling mode** — Alarm is issued when unit discharge temperature is not below the cooling mode error set point.

### Configuration to normalize alarm

When unit discharge temperature rises above the heat mode error set point, the heat mode alarm is normalized. When unit discharge temperature drops below the cool mode error set point, the cool mode alarm is normalized.

For example, the Heating/Cooling Mode Error set points are 90 and 55 F. During a heat mode, after 10-minute heating period, if discharge temperature does not increase above 90 F, a heat mode error is generated. After discharge temperature increases above 90 F, the alarm is normalized.

During cooling mode, after a 10-minute cooling period, if discharge temperature does not drop below 55 F, a cool mode error is generated. After the discharge temperature decreases below 55 F, the alarm is normalized.



**Fan status alarm** — Refer to the Fan Status Alarm table for specifications.

### FAN STATUS ALARM

FUNCTION	DESCRIPTION
<b>Controllers</b>	Monitor Thermostat
<b>Sensor Required</b>	Airflow, Digital Input
<b>Sensor Wiring</b>	Terminals 8 and 9 of 33CSUCE-06 Relay Pack or Wire to Damper Board
<b>Input</b>	Open Contacts at Sensor from Lack of Airflow
<b>Output</b>	Alarm SE-06, Cannot Detect Fan ON Alarm SE-12, Cannot Detect Fan OFF
<b>Configuration Option</b>	Fan Status
<b>Configuration Values</b>	Default OFF, Min OFF, Max ON
<b>Configuration Increments</b>	None
<b>Associated Functions</b>	Fan Operation for Heat

#### Operation

*The detecting or verifying fan is running. The fan relay is on or Heat 1 relay is on.*

When the monitor thermostat indicates commanded state of FAN (relay) is on, but flow switch indicates no airflow after 30-second time delay (sensor contacts still open), an alarm condition is initiated (heat or cool or ventilation mode).

When the monitor thermostat indicates commanded state of HEAT 1 (relay) is on, but flow switch indicates no airflow after 120-second delay time (sensor contacts still open), an alarm condition is initiated. This delay time allows for units having internal control of heat, versus thermostat control of heat.

When an alarm condition is initiated:

- system mode (either heat or cool) is dropped
- alarm SE-06, Cannot Detect Fan ON, is issued
- a manual reset is required to reset the alarm

→ *Detecting or verifying fan is OFF. Fan relay is OFF and Heat 1 relay OFF.*

When the monitor thermostat indicates commanded state of FAN (relay) is OFF, but flow switch indicates that airflow still exists after 120-second delay time from fan off command (sensor contacts still closed), an alarm condition is initiated.

When alarm condition is initiated:

- heat, cool, and fan are shut off
- alarm SE-12, Cannot Detect Fan OFF, is issued
- a manual reset is required to reset the alarm

#### Configuration example

The Fan Status Switch option is set to ON.

At the start of a cooling mode, the fan relay is switched on by the monitor thermostat. Fan operation is initiated and the fan has 30 seconds to generate sufficient airflow to close the normally-open fan-status flow switch. If the sensor contacts are closed within 30 seconds, the system operates normally and no Fan Status alarm is generated. If, however, the sensor contacts are not closed within 30 seconds, an

alarm is generated. The thermostat display will not indicate “fan” until fan operation is verified by the fan-status flow switch.

The alarm will cause the system to shut down. No cooling, heating, or ventilation is available until a reset of the system is initiated.

In a heat mode, the same sequence is followed, except that the delay time is increased to 120 seconds. If the Fan Operation for Heat option is configured OFF, no alarm is generated in the heat mode.

**Filter status alert** — Refer to the Filter Status Alert table for specifications.

### FILTER STATUS ALERT

FUNCTION	DESCRIPTION
<b>Controllers</b>	Monitor Thermostat
<b>Sensor Required</b>	Filter, 33CSFS--01, Digital Input
<b>Sensor Wiring</b>	Terminals 10 and 11 of 33CSUCE-06 Relay Pack or Wire to Damper Board
<b>Input</b>	Closed Contacts from High Pressure Drop
<b>Output</b>	Alarm (SE-09), Dirty Filter
<b>Configuration Option</b>	Humidity Sensor/Filter Status Switch
<b>Configuration Values</b>	Default 0, Min 0, Max 2 to activate
<b>Configuration Increments</b>	None
<b>Associated Functions</b>	None

#### Operation

This alert is used to indicate the status of the filters in the HVAC unit. The Dirty Filter alert indicates a high pressure drop across the filters, caused by collection of excessive particles and debris on the filter media.

Pressure drop across the filters in the unit increases until it reaches the Filter Status sensor’s set point. This causes the contacts of the sensor to close. The contact closure of the sensor is detected by a discrete input. If the contacts remain closed for 10 minutes, a Dirty Filter alert is initiated.

A manual reset is required to clear this alert.

#### Configuration example

The Filter Status sensor will close contacts (alert) when differential pressure increases from zero (clean filter, no restriction, or pressure drop across filter) to the sensor set point (dirty filter with restriction across filter). The Humidity Sensor/Fan Filter Switch option is set to specify the filter status switch.

During operation of the unit over a period of time, an SE-09 error is declared. This indicates that the differential pressure across the filters has increased beyond the set point value of the sensor. The Alternate Information “Dirty Filter Status” (information item 10) will read ON, also indicating a dirty filter.

After the dirty filters are changed, the Dirty Filter Status must be manually reset. The system then returns to normal operation and will not alert until the differential pressure set point of the Filter Status sensor is again reached.

# Application data (cont)



**Indoor-air quality status alarm** — Refer to the IAQ (indoor-air quality) Status Alarm table for specifications.

## IAQ STATUS ALARM

FUNCTION	DESCRIPTION
Controllers	Monitor Thermostat, Zone Controller, Bypass Controller
Sensor Required	IAQ (CO <sub>2</sub> ) Sensor
Sensor Wiring	Pins 6 and 7 of Relay Board or Wire to Damper Board
Input	Closed Contact when Level Exceeded.
Output	SE-10
Configuration Option	System IAQ Local IAQ Sensor
Configuration Values	ON ON
Configuration Increments	Not Applicable
Associated Functions	None

### Operation

When the CO<sub>2</sub> level exceeds the preset level, the sensor signals the monitor thermostat. The monitor thermostat will wait until the IAQ Alarm Delay option has expired, then it will issue an SE-10. The system (if configured) will bring in fresh outdoor air to meet IAQ requirements.

When the CO<sub>2</sub> level exceeds the preset level (factory configuration is 1000 ppm and cannot be changed without optional software), the sensor signals the monitor thermostat. The monitor thermostat energizes the indoor-fan motor (if not already running) for 5 to 30 minutes (field-configured). If the Auxiliary Relay has been configured for IAQ operation, the monitor thermostat energizes the relay. This is intended for use with an economizer, but can be wired to an exhaust fan or HRV. If used with an economizer, the economizer moves to the minimum position and the indoor fan circulates the air throughout the occupied space.

The monitor thermostat has 3 lockout features which will prevent IAQ mode if the outdoor humidity is too high or the outdoor temperature is too high or too low. When the monitor thermostat energizes the auxiliary relay, it tells the zone controllers and bypass controller.

When the monitor thermostat receives an IAQ alarm from a bypass controller (or itself in monitor-only mode), it sends all the zone controllers the system IAQ alarm.

At the end of the 5 to 30 minutes, if the CO<sub>2</sub> level still exceeds the set point, the indoor fan will stay energized. The economizer damper opens and the zone damper moves to the full open position. This forces fresh outside air to enter the zone with deficient IAQ. When the IAQ level drops below the IAQ set point, the economizer and zone dampers return to their standard operating mode.

→ When the system is bringing in additional outside air, the thermostat is reset 0° to 10° F (field-configured) above the heating set point and below the cooling set point to allow the outside air to circulate before the heating or cooling mode is initiated. The monitor thermostat will display status when the system is in this mode.

**Communication failure alarm** — Refer to the Communication Failure Alarm table for specifications.

## COMMUNICATION FAILURE ALARM

FUNCTION	DESCRIPTION
Controllers	Monitor Thermostat, Zone Controller, Bypass Controller
Sensor Required	None
Sensor Wiring	None
Input	Network Devices
Output	SE-05 Communication Failure
Configuration Option	None
Configuration Values	None
Configuration Increments	None
Associated Functions	None

### Operation

The devices in the system communicate and share information. The monitor thermostat has the role of verifying that it can communicate with each device associated with its system. During a scan, the monitor thermostat starts at the address below its own address and proceeds to scan in descending order, checking addresses. It stops the scan when it reaches address 1. If it does not detect any devices or is unable to scan the network, then the monitor thermostat will issue an SE-05 error.

When the monitor thermostat cannot communicate with all associated zone controllers or system devices, a System Error SE-05 will be initiated. The error indicates that the monitor thermostat is unable to establish communication contact with the device in question.

The communication error will automatically clear when the monitor thermostat establishes communication with the associated zone controller or system device.

**Stuck gas valve alarm** — Refer to the Stuck Gas Valve Alarm table for specifications.

## STUCK GAS VALVE ALARM

FUNCTION	DESCRIPTION
Controllers	Monitor Thermostat
Sensor Required	N/A
Sensor Wiring	N/A
Input	Duct Temperature Sensor (Damper)
Output	SE-13, Stuck Gas Valve Alarm
Configuration Option	None
Configuration Values	None
Configuration Increments	None
Associated Functions	None

## Operation

The Stuck Gas Valve sequence is used to allow the system to properly react to a failure mode of the HVAC unit when the gas valve becomes stuck in the open position. When this condition exists, the unit is unable to shut off the heat. To minimize this problem, the internal limit switch trips causing the indoor fan to turn on and remain on until the gas is manually shut off and the heat exchanger cools to normal temperatures.

Without this feature, a VVT® system operating normally would close each of its zone dampers as space conditions warmed to set point. This causes the heated air to be re-circulated back through the unit, further aggravating the overheating problem. With the Stuck Gas Valve sequence, the VVT dampers open to their configured maximum damper position. This allows space temperatures in the building to rise to higher than normal temperature levels. However,

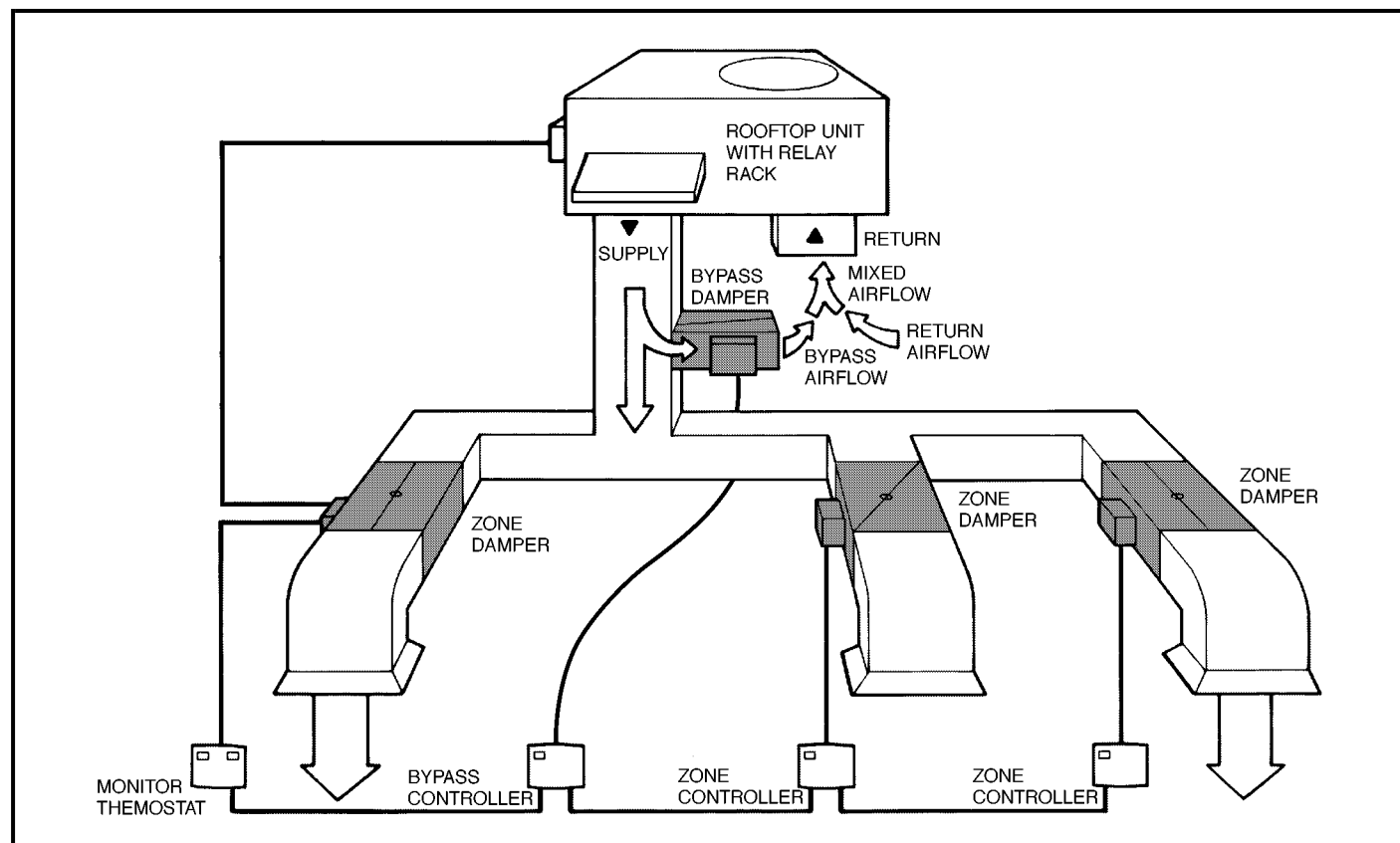
this sequence reduces the temperature build-up in the unit and keeps the heat exchanger operating within temperatures to prevent failure.

*During no system mode* — If the duct temperature rises to greater than 175 F, the indoor fan is started. The fan will remain on if that temperature does not drop below 150 F after 3 minutes. The bypass damper will be closed, and all zone dampers will open to their maximum position. A Stuck Gas Valve alarm (SE-13) will be initiated.

→ *During a cooling mode* — If the duct temperature does not drop below 100 F within 10 minutes, the cooling mode will be dropped for 10 minutes. The “No System Mode” logic will test for this condition.

*During a heating mode* — No action is required in this mode.

## Typical VVT system installation



## Multiple Zone HVAC Control System

Model Number: **33CSVMT** (VVT® Monitor Thermostat with Timeclock)

**33CSVM** (VVT Monitor Thermostat without Timeclock)

**33CSZC** (Zone Controller)

**33CSBC** (Bypass Controller)

### Part 1 – General

#### 1.01 SYSTEM DESCRIPTION

The system shall consist of a multiple zone capacity programmable, communicating monitor thermostat, with multiple zone controllers, and a bypass controller. The system shall also include a complete array of sensors and input components. The system control devices shall be capable of stand-alone application or as a multiple system networked in a communication bus. The system components shall operate and be configurable without the use of a computer, but shall provide the capability of both local and remote network access through a computer.

#### 1.02 QUALITY ASSURANCE

The control system shall be designed to conform to UL and CSA standards. Controllers shall be manufactured within an ISO-9000 certified facility.

#### 1.03 DELIVERY, STORAGE AND HANDLING

The system control products shall be stored and handled per manufacturer's recommendations.

### Part 2 – Products

#### 2.01 EQUIPMENT

##### A. General:

The control system shall be available as a complete package, with the required input sensors and additional control components readily available. It shall provide complete control of the HVAC system including: unit, bypass airflow system, and zone control. Individual zones in the system shall have the capability to provide supplemental heat and pressure independent operation. Each device in the system shall be capable of "self-test" on-board diagnostics which communicate alarms and operating status. Unit control relay packs shall be available factory-installed with direct connection to the field-installed monitor thermostat.

##### B. Memory and Timeclocks:

The system components shall operate without the use of battery back-up to support time clocks and non-volatile memory storage. The timeclocks must be capable of retaining the correct time for a minimum of 10 hours and the non-volatile memory storage shall be indefinite during a power interruption. The system shall restart itself and immediately begin normal operation when power is restored.

##### C. Stand-Alone Capability:

The system shall be capable of operating as a stand-alone system and not require a computer to prompt any functions for normal operation. The system shall be capable of interface to a computer either remotely or locally for purposes of diagnostics, programming, monitoring, and data logging.

##### D. VVT Monitor Thermostat:

1. Shall include zone and unit control capabilities.
2. Shall include an electronic control that shall determine the demand for heating or cooling based on the space demand.
- 3. Shall have the ability to operate the system fan either automatically, with the fan switch on AUTO (fan operation only during a system occupied heating or cooling mode), or continuously during the occupied mode with the fan switch set to ON. Fan operation during unoccupied mode shall be automatic. Heat, Cool, and Fan switches shall be accessible and changeable from a remote location. The system shall provide both commanded and actual fan status.
4. Shall have the ability to protect the system configuration from tampering and misuse by providing a minimum of 4 levels of security access into the thermostat control. Access levels shall range from allowing no configuration changes at the system control to allowing full configuration at the system control. Access levels within that range shall provide for user comfort adjustments of temperature and schedule of use.
5. Shall have the ability to automatically or manually change-over between heating and cooling.
6. Shall be capable of monitoring supply air temperature and utilizing this information as a safety device to deenergize stages of heating or cooling when adjustable equipment temperature limits are exceeded. Individual configurable temperature values for first and second stage both heating and cooling limits shall be selectable.
7. Shall include the capability to prevent unnecessary operation of second stage when on-board trending indicates that first stage can satisfy space demand.
8. The control system shall provide protection from the unit being intermittently sequenced from heating to cooling until the Time Guard® time period has elapsed. The Time Guard time period shall be a minimum of 5 minutes and shall vary with control system thermostat identification number or address. An integral override feature shall be provided to allow service troubleshooting to be performed without waiting for the Time Guard interval.

9. The system shall provide adjustable minimum run times during both heat and cool modes.
10. System shall have the capability to open and hold open all associated zone dampers in the event of a unit gas valve becoming stuck in the open position.
11. The monitor thermostat shall be capable of receiving and broadcasting both humidity and outside-air temperature information to the network communication bus.
12. Shall have the ability of establishing separate adjustable heating and cooling lockout temperatures based on outside air temperature. These temperatures shall be individually configurable and will prevent unnecessary operation of heating/cooling within the bounds of the lock-out temperatures.
13. Shall have the capability to alarm on adjustable unit discharge temperature for both heating and cooling. Shall have the ability to provide for unit reset when required for servicing purposes.
14. System shall have the ability to automatically stagger the start times of multiple units upon power up following a power failure.
15. Unit control relay pack shall be available with an outdoor duty rating, suitable for installation and operation in outdoor applications.
16. Calibration of the system sensors shall be adjustable from the monitor thermostat without requiring the sensor to be taken out of service.
17. Shall have an on-board timeclock capable of broadcasting to the network. It shall be capable of receiving time broadcasts from other network devices. The clock shall support 365-day scheduling, with integral Daylight Savings and leap year capability. The clock shall be configurable in one minute increments. The clock shall also have the ability to be brought off-line via software both locally and remotely. Shall be capable of 18 holiday schedules with up to 99 days per schedule.
18. Shall be capable of establishing, adjusting, and storing both an occupied and unoccupied program format on a daily basis. Scheduling increments shall be in 1-minute sectors, with 8 program periods available.
19. Shall be capable of either following its own program schedules for occupied and unoccupied operation or follow the program schedule of another device on the network communication bus.
20. Shall have integral unoccupied override capability to provide up to 4 hours of additional occupied operation without additional programming.
21. Shall be capable of displaying separate heating and cooling set points and additional diagnostic information. Diagnostic information shall include: current system mode, time of day, security access level, space temperature, supply-air temperature, outside-air temperature, relative humidity, fan status, filter status, and indoor air quality (IAQ) status.
22. Shall be capable of displaying temperature information in Fahrenheit or Celsius temperature scales in increments of one tenth of a degree. The capability shall be provided to display space temperature and set point on a rotating basis.
23. Shall include an adjustable set point limiting feature to allow a high and low range set point limit.
24. Shall have an on-board space temperature sensor. The VVT® monitor thermostat shall also be capable of remote space sensing from a location away from the thermostat when using a Remote Room Sensor. Capability shall be provided to read space temperature separately from the local VVT monitor thermostat, from the Remote Room Sensor, or to read an average from the local and up to 4 Remote Room Sensors.
25. Shall include the ability to display system diagnostics to indicate system operation, operating alarms, or service requirements. Alarms shall include fan status, filter status, IAQ status, unit supply air temperature for both heating and cooling, and network communication errors.
26. Shall include an integral zone usage meter to read and store (in minutes) the amount of time zone demand matches the system mode, the amount of time the system is in unoccupied override, and the amount of time the zone demand matches the system mode during unoccupied override.
27. Shall have the ability to provide demand ventilation IAQ control through the economizer with an indoor air quality sensor. The sensor shall measure the amount of CO<sub>2</sub> present and control the amount of outside air entering the conditioned space. The IAQ sequence shall provide high and low temperature lockout, space temperature reset, adjustable delay time for alarm notification, and adjustable time delay for economizer.
28. The IAQ sensor shall be available in duct mount, wall mount, and wall mount with LED display. The IAQ set point (ppm) shall be adjustable.
29. The system shall have the capability to provide pre-occupancy purge for one hour before occupancy to flush the building with outside air.
30. The monitor thermostat shall have the capability of providing control of the HVAC unit before all of its associated zone controllers are installed. This construction mode capability shall be changeable to a Monitor-Only or VVT Monitor mode following completion of zone damper installation.

## E. System Coordination Capabilities

1. VVT® system shall include adjustable mode demand to indicate the minimum number of zones required to initiate a system heating or cooling mode.
2. VVT monitor thermostats shall have a communication range of either 4, 16, or 32 to scan the system zone controllers and a bypass controller.
3. VVT system shall have the ability to perform a system communication check to identify the zone controllers and bypass controller. The check shall identify their respective unique device identification address, whether the device has an error condition, and if the zone control device has a requirement for heating or cooling (zone heating or cooling caller).
4. VVT monitor thermostat shall have the ability to process the information received from its system zone controllers and determine the suitable system mode (heating or cooling).
5. VVT monitor thermostat shall have the capability to modify the time period used to select the system to prevent getting locked into one mode.
6. System shall have an indoor air quality (IAQ) sensor available as an accessory which will measure the amount of CO<sub>2</sub> present. The amount of outside air being sent to the space will be increased if the reading is above the configured set point. The IAQ sensor for the system can be wired to the unit control relay pack or bypass damper. Individual zones with a requirement for an individual IAQ sensor shall have that sensor wired to the damper.

## F. VVT Zone Controller

1. Shall have the capability for independent zone control when used with a with VVT monitor thermostat (excluding direct HVAC unit control.) This capability shall include, but shall not be limited to: configuration access protection, sensor calibration, individual zone set points, occupied/unoccupied schedule, unoccupied override, display of set points and zone diagnostic information, remote temperature sensing and averaging, zone IAQ status, alarming capability, and metering.
2. Shall have the capability of controlling zone supplemental or auxiliary heat sources, including fan control when required, independently from central HVAC unit fan control. Conversion to supplemental heat capability shall not require the replacement of the control system.
3. Shall have the capability of providing either pressure independent operation or pressure dependent damper operation. Damper inlet area shall be adjustable in increments of one square inch.

4. Shall have the capability of reading zone airflow in cfm, and controlling zone airflow based upon this information when operating in pressure independent mode.
5. Shall have a programmable ventilation mode capable of providing ventilation to its zone at all times. The ventilation mode shall have ability to be terminated if the supply-air temperature is not beneficial to the zone.
6. Shall have the ability to establish adjustable damper maximum open, minimum open, and damper ventilation minimum airflow positions.
7. Shall have the ability to operate an actuator designed for use in applications requiring greater than 1 in.wg static pressure for proper operation.
8. Shall be capable of following its own occupied schedule or that its associated VVT monitor thermostat.

## G. Bypass Controller

1. Shall include the ability for damper pre-positioning to the full open position prior to fan operation.
2. Shall include an automatic heating/cooling mode temperature change-over cycle with adjustable temperature set points to eliminate zone thermal shock during periods of system mode change.
3. Shall include central airflow damper position control of all individual zone dampers from one location to maximize air balancing operation.
4. Shall include a set-up function to determine and automatically configure the bypass system maximum and minimum pressure set points.
5. Shall have the capability of displaying duct temperature, damper position, maximum pressure set point, and current system static pressure.
6. Shall have the capability to configure and adjust for maximum airflow open position.
7. Shall have the ability to protect the device configuration from tampering and misuse by providing levels of security access into the control.
8. Shall have the capability to initiate an IAQ sequence for its zone upon input from an IAQ sensor. It shall also have the capability of providing IAQ control to its individual zone upon input from its specific IAQ sensor.
9. Shall have the ability to operate in a stand-alone mode configuration without being networked into the system.
10. Shall have the capability of unit reset for servicing purposes.

- H. Each Zone Damper shall include:
1. A motorized damper assembly constructed of 24 gage galvanized iron with blade of 20 gage.
  2. Blade operation providing full modulation from open to closed position.
  3. The ability to operate in a master/slave arrangement, where the master damper is operated by the zone controller. The master damper shall have the capability to have up to 3 dampers tracking its position. The slave dampers shall modulate to the same position as the master damper.
  4. Round dampers shall have elliptical blades with a seal around the entire damper blade edge. Rectangular dampers shall have fully sealed edges.
  5. A duct temperature sensor shall be an integral part of the damper assembly.

## 2.02 SEQUENCE OF OPERATION

The VVT® System shall control the HVAC units in the following manner:

- A. The VVT monitor thermostat shall determine the demand for heating or cooling based on the number of zones calling or the greatest demand for a particular mode. The VVT monitor thermostat will establish the zone with the greatest demand as the Reference Zone.
- B. The VVT monitor thermostat shall communicate with its zone controllers and bypass controller on a communication bus network.
- C. The VVT monitor thermostat shall access zone demand for heating and cooling from each zone slave thermostat and use this information to control the HVAC unit based on zone demand.
- D. When any thermostat senses a temperature deviation of 1.5° F or more from its current set point, it becomes a zone heating or cooling caller. When a zone becomes a caller, the monitor thermostat registers its demand and its heating or cooling caller status. When the monitor thermostat registers the minimum required number of zone callers, as determined by the system mode demand, a mode is selected. The mode selected shall meet all lockout temperature criteria (if applicable). The monitor thermostat shall energize that specific mode.
- E. On a rise to 2° F the monitor thermostat shall energize second stage if the temperature trending program allows second stage operation. When demand falls to 1.0° F, the second stage is released. When demand falls to 0.5° F, the first stage is released.
- F. The monitor thermostat shall hold the system mode until the Reference Zone is within .5° F of its set point or until the system mode reselect time limit has expired and the system demand is such that the monitor thermostat selects the opposite mode.

- G. The bypass controller shall pre-position its damper(s) to the maximum open position prior to system start-up. The bypass controller shall regulate pressure from minimum system pressure during start-up to maximum system pressure during normal operating conditions. The bypass controller shall monitor supply- air temperature. During changeover mode, the bypass controller shall open the bypass dampers to pre-condition the supply air if it is needed by the Reference Zone.

- H. The individual zone controllers shall be capable of operating in the ventilation mode until the zone becomes 1.5° F out of set point in either direction. At this point the zone controller shall request the appropriate mode from the monitor thermostat.

## 2.03 SOFTWARE

- A. Access capability to the system, whether local or remote, shall be accomplished using the Carrier System Software. Software access shall not require any changes or modifications to the VVT control devices or associated system sensors.
- B. The software shall be capable of, but not limited to: listing all current system sensor readings, listing and modifying configuration parameters such as occupancy schedules, set points, alarm options, and temperature limits.
- C. The software shall be capable of providing levels of access into the system from simple monitoring to full monitoring and modifying system configurations for all components.

## 2.04 SERVICE AND WARRANTY

- A. After installation, system start-up shall be completed. All thermostats and related components will be adjusted. The equipment being controlled by the specified control system shall be in operation and fully checked. The entire system must be in operation for 24 hours prior to seeking acceptance from the owner/engineer.
- B. The control system herein specified shall be free from defects in workmanship and material under normal use and service. If, within 12 months from date of acceptance by owner/engineer, any of the equipment herein described is proved to be defective in workmanship or material, it will be repaired, adjusted, or replaced free of charge by the installing contractor.



**Manufacturer reserve the right to discontinue, or change at any time, specifications or designs without notice and without incurring obligations.**